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SPARC

Stratosphere-troposphere Processes And their Role in Climate

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Lenticular clouds form over the Crown Range in New Zealand as strong winds are forced over the mountain range. A team meeting of the SPARC Gravity Wave Activity discussed parametrisation of drag created in such conditions in models, and how to improve observations and modelling of orographic wave drag (see report on page 31).

Photo credit: Katja Riedel Photography

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WCRP World Climate Research Programme
WORLD METEOROLOGICAL ORGANIZATION
United Nations Educational, Scientific and Cultural Organization
Intergovernmental Oceanographic Commission
International Science Council

The SPARC newsletter welcomes historical notes. Background information about previous endeavours to obtain atmospheric data, to build comprehensive analyses, and to infer general characteristics can help to put current SPARC activities in perspective. Contributions and comments should be submitted to the SPARC International Project Office at **office@sparc-climate.org.**

Previous SPARC newsletter articles with historical topics include:

A. Brewer, 2000: The stratospheric circulation: A personal history. *SPARC Newsletter* No. **15**, 28-32.

M.-L. Chanin, 2004: A Short History of the Beginning of SPARC and its Early Development. *SPARC Newsletter* No. **22**, 10-12.

S. Brönnimann *et al.*, 2015: Bicentenary of the great Tambora Eruption. *SPARC Newsletter* No. **45**, 26-30.

K. Hamilton, 2018: James Sadler and the Discovery of the Stratospheric Quasi-biennial Oscillation. SPARC Newsletter No 51, 32-35.

Ernest Hovmöller's diagram – the illustrative link of time with longitudes and altitudes is turning 70

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Historical note

This note recalls the first publications of Hovmöller-diagrams seventy years ago, partly addressing stratospheric data, alongside with international cooperation and newly established scientific journals during the years following the end of the Second World War.

The protagonist is the Danish meteorologist Ernest Hovmöller (1912-2008) who, in 1946, had started working for the Swedish meteorological and hydrological institute SMHI after a move from its Danish counterpart DMI (Persson, 2017). Soon after he began cooperating with Carl-Gustaf Rossby (1898-1957), arguably the most prominent dynamical meteorologist of the time, who permanently returned to Sweden in 1947, after two decades in the United States, and who started the research journal *Tellus* in 1949. Another cooperation partner of Hovmöller's was the Italian geophysical all-rounder Mario Bossolasco (1903-1985), founding and long-standing editor (1939-73) of the journal *Pure and Applied Geophysics* and in 1950 instigator of the biennial International Conferences on Alpine Meteorology (ICAM; Volkert, 2009; the 35th realization is scheduled for September 2019). Portraits of the three colleagues are juxtaposed in Figure H1.

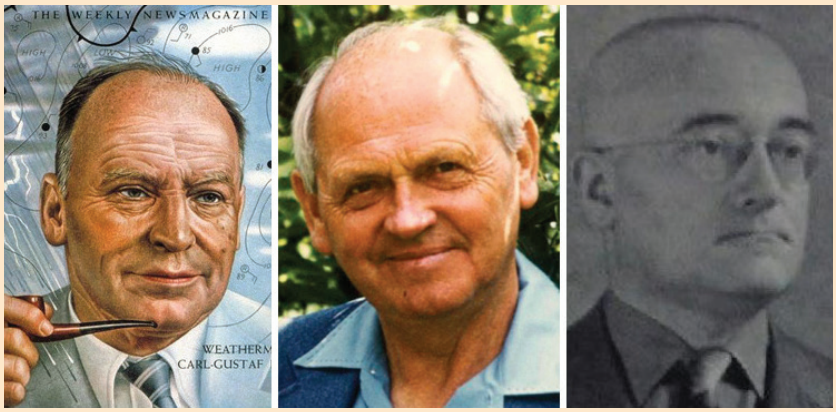

Figure H1: Three geophysical all-rounders, who cooperated around 1950 (from left): Carl-Gustav Rossby (1898-1957; depicted as "Weatherman Carl-Gustav Rossby" on the front page of TIME magazine, 17 Dec. 1956 [© TIME USA, LLC.]), Ernest Hovmöller (1912-2008; from Persson 2017), and Mario Bossolasco (1903-1985; from the web).

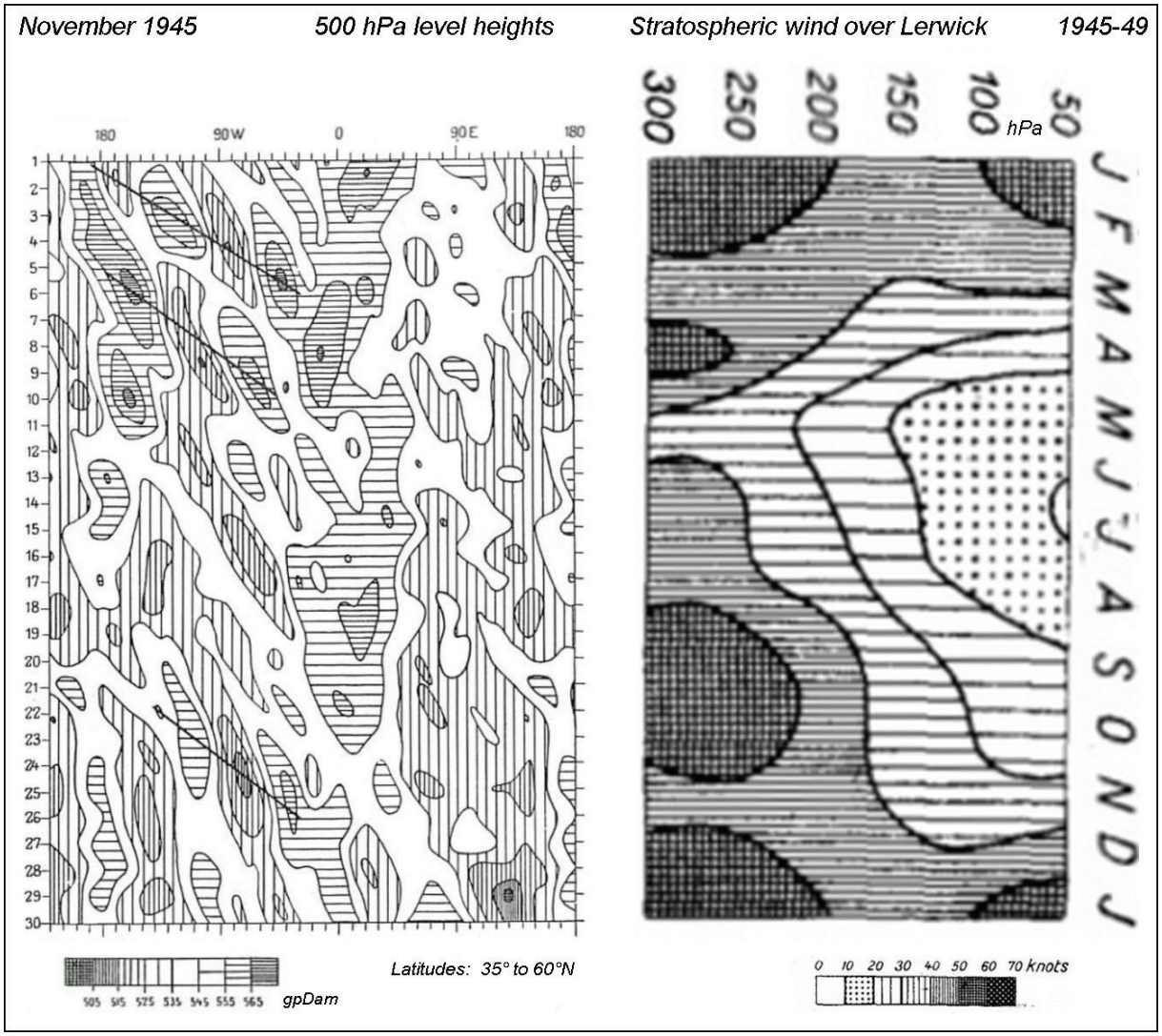

Figure H2: The two earliest published realizations of Hovmöller diagrams: time-longitude variations of 500 hPa geopotential heights during November 1945, averaged over 6 latitudes in a 25°-wide band (left; from Hovmöller, 1949) and mean annual variation of stratospheric wind speed from a five-year dataset of Lerwick sounding station (60°N, 1°W; right; adapted from Hovmöller 1950).

Not only nowadays, but also during the 1940s, data measured along the five dimensions of atmospheric research began to abound. It was, and continues to be, a considerable intellectual challenge to sufficiently reduce the observations made of (i) different physical quantities, (ii) over time, and (iii) to (v) along the three spatial dimensions in order to gain a general understanding of atmospheric motions and their dynamics. In a shorter contribution of less than five pages, Hovmöller (1949) introduced a through-ridge diagram which condensed a month-worth of 500-hPa-level heights as observed within the latitude belt 35° to 60°N roundabout the Earth. What then appeared as Figure 1 is reproduced here as the left part of Figure H2. Time proceeds downwards along the ordinate while geographical longitudes run along the abscissa. The latitudinal averaged height band from 5350 to 5450 gpm is left white, while the adjacent bands of lower (higher) values are given vertical (horizontal) hatching of increasing density. Due to this ingenious design three (or even four) trains of quasi-uniformly progressing anomaly patterns become visible to the west of the Greenwich meridian within the otherwise rather arbitrary fluctuations. Hovmöller determined average progression speeds and related them to Rossby's previously described concept of group velocities for planetary waves.

In September 1950, Hovmöller was an invited participant at the inaugural ICAM in Milano (Bossolasco, 1950). In the afternoon of the first day, he presented his study entitled "*Zonal and meridional air currents in the stratosphere over Europe*",

which focused on the average annual variation of stratospheric winds, *i.e.* in the height range 300 to 50 hPa, obtained from regular radiosondes ascents made at the stations Larkhill and Lerwick, in southern England and northernmost Scotland, respectively. The study was published in the 1950 autumn edition of the journal founded by Bossolasco (Hovmöller, 1950) and contained in its Figure 1 the diagram on the right side of Figure H2 here. The diagram was rotated by 90° in order to have the months along the ordinate and pressure levels along the abscissa. Striking is the wind speed maximum extending also to the higher levels during the winter months, which was found more pronounced at the higher latitude. Additionally, time-series over selected months were used to depict the considerable day-to-day fluctuations.

Anticipating the routine of meeting reports about conferences and workshops in the SPARC newsletter (no less than four in this issue), Hovmöller (1951) reported about the inaugural ICAM in *Tellus*, without relating to his own contribution. In the following issue, his mentor Rossby (1951) explicitly mentioned the cooperation with Bossolasco, involving Hovmöller, as an encouraging sign that extended working relations between various institutes started to increase also within post-war Europe. UNESCO and WMO were mentioned as possible sponsors. As WCRP is approaching its 40th anniversary and SPARC having started its second quarter of a century, the visionary, yet clear and also critical thoughts of Carl-Gustav Rossby about cooperative projects continue to be fascinating reading.

And finally, we note that Rossby was preparing his trip as president of IAMAS to the IUGG general assembly scheduled in Toronto, when a heart attack in his office at the University of Stockholm ended his life on 19 August 1957. This month, IUGG and IAMAS are remembering their centenary (*cf.* MacCracken and Volkert, 2019) at the 27th general assembly in Montréal (see note on page 40) and, later, with a special celebration at UNESCO in Paris. The three cooperation partners depicted in Figure H1, their published achievements and easily accessible reports about their meetings, are to be regarded as still relevant parts of the ever growing mosaic of knowledge derived from the atmospheric sciences, very often by international cooperation on a voluntary basis.

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